Statistics 421/621 – Applied Time Series and Forecasting
Spring 2020

Lecture: TR 9:25-10:40am**,** DCH 1064
Discussion Session: W 4-5:30, Herzstein 210

Instructor: Dr. Kathy Ensor; x4687; ensor@rice.edu
Office Hours: Tuesday from 11 to noon or by appointment

TA: Joe Feldman; jrf11@rice.edu
Discussion Session Time: W 4-5:30, Herzstein 210

Course Objective: To educate students on the foundation and practical implementation of time series methods and forecasting. Examples will come primarily from a broad spectrum of problems in engineering, science, social science and business including financial applications.

Textbook: (pdf's of books are freely available)

- I will be uploading a text that reflects the lectures. Material will be taken from the following texts (with the first two serving as the primary source).
- Time Series Analysis and Its Applications with R Examples by Shumway & Stoffer, 4th Edition. http://www.stat.pitt.edu/stoffer/tsa4/
  - R package for this text is **astsa**
- Forecasting: principles and practice by Rob J. Hyndman and George Athanasopoulos is found at https://www.otexts.org/fpp. We will use this text at the beginning of the course while studying simple forecasting strategies.
  - R package associated with this text is **forecast**
- *In the past I have used: The Analysis of Financial Times Series* by Ruey Tsay, 3rd Edition (Data sets; errata). This is an excellent text that provides another perspective. There should be copies around.

Computing Required: This course will require a substantial amount of computing and data analysis, relying on the statistical software package R (https://www.r-project.org/) through RStudio (http://rstudio.org/).

Assessment:

- 35% HW, quizzes and data assignments. Unless otherwise noted, you may work together on homework. Quizzes should be taken independently.
  - Active class participation and attendance is expected. In class quizzes (announced and unannounced; up to 5 points each)
  - Weekly HW assignments; reviewed for completion only. Due each Thursday at noon. HW solutions will be uploaded Thursday by 1pm. (1 pt each)
  - Weekly Canvas quizzes covering the HW assignment. The quiz will be available Friday morning and due by noon on Saturday (9 pt each)

    - Two data analysis focused homeworks OR in class analyses. Each worth 15 points. You may work in groups up to 5.
- 65% 2 Exams
    - Exam 1 – in class closed book – March 5th
    - Exam 2 – TWO **CHOICES (you must choose you may not take both)**
        - April 23, in class closed book over material since the first exam. Exam 1 and 2 will be equally weighted.
        - Comprehensive final scheduled by registrar during the finals period.
            - If final exam grade is less than first exam grade, exam grades are equally weighted
            - If final exam grade is greater than first exam grade, the final will be given 25% more weight than the first exam.
- There will be additional exam and homework questions for STAT 621 students based on the assumption of graduate level background knowledge in statistics.

Disabilities: I encourage any student with a disability that requires accommodation to let me know as well as Rice Disability Support Services.

Topics – general guidance (timeline is approximate)

- Jan 13 - 24: Time series graphics, nonparametric time series decomposition, smoothing and forecasting. Characteristics of time series. Statistical summaries of time series (ACF, PACF).
- Jan 27 - Mar 3: Time series models.
    - WN, ARIMA, ARMAX.
    - VAR
    - ARCH, GARCH
    - Model comparisons; Tests of nonstationarity
- Mar 5 Exam 1
- Mar 9 – Mar 31: Spectral Methods.
    - Periodogram – sinusoidal regression
    - Spectral density
    - Duality with time domain
    - General functional time series
- Apr 2 – Apr 21: State-Space Models.
    - Local level model
    - Kalman filter, smoother and forecast
    - ARMAX as State Space model
    - Regime switching
    - Stochastic volatility
    - Time varying coefficient models
- Apr 23 Exam 2 **OR** Registrar Scheduled Comprehensive Final